

Young Stellar Objects in the Spitzer Galactic First Look Survey

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ABSTRACT

The Spitzer First Look Survey (FLS) is a characteristic “first-look” at the mid-infrared sky at sensitivities that are 100 times deeper than previous systematic large-area surveys. The Galactic FLS (GFLS) was allocated 36 hours to survey the molecular cloud L1228 and several low galactic latitudes at galactic longitudes 254.4 deg and 105.6 deg. This poster summarizes some early scientific results from the GFLS pertaining to young stars. We present SEDs and color-color diagrams using 2-MASS, IRAC and MIPS photometry of young stellar objects in the GFLS.

1. What is the FLS?

On behalf of the Spitzer user community, the SSC conducted a First-Look Survey (FLS) as one of the first science tasks during nominal operations, which started on day 98 of the mission.

The primary goals of the entire FLS are (1) to provide a characteristic “first-look” at the mid-infrared sky at sensitivities that are ~ 100 times deeper than previous systematic large-area surveys; and (2) to rapidly process the data and place it into the public domain.

The FLS used two Spitzer instruments, IRAC (imaging at 3.6, 4.5, 5.8, 8 microns) and MIPS (imaging at 24, 70, and 160 microns), and had three components: Extragalactic (XFLS), Galactic (GFLS), and the Ecliptic (EFLS). This poster discusses some of the observations of young stellar objects in the GFLS in two fields, L1228 and 105.6+4.

For the 36 hrs allocated to the GFLS, the overall goal is to characterize cirrus and source counts in different galactic environments. Visualizations of the main portion of the GFLS survey appear in Figure 1.

In addition to the main survey illustrated in Figure 1, IRAC and MIPS scans of L1228 (a known molecular cloud) and small IRAC-only maps to sample the Galactic disk and to compare to the ISOGAL survey were taken at $l=97.5^\circ$, $b = 0$, ± 4 , 16° .

2. L1228 South Aggregate

For much more information, please see Padgett et al., ApJS, in press.

Figure 2 presents some SEDs of objects in a stellar aggregate just south of L1228, and Figure 3 compares IRAS and MIPS observations of the same region.

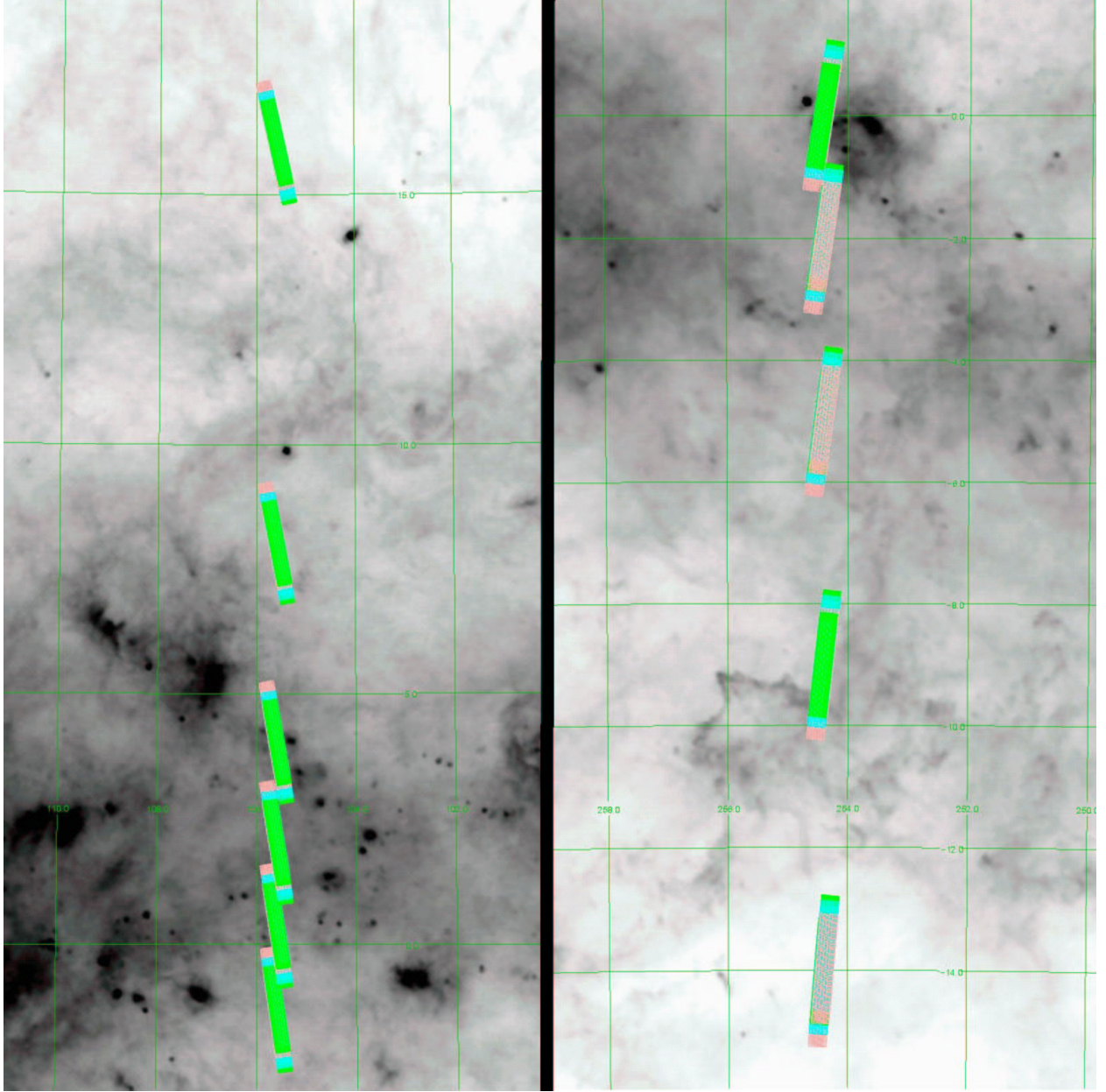


Fig. 1.— *Visualization of MIPS observations of the $l=105.6^\circ$ (left) and 254.4° (right) strips on an IRAS 100 micron image. (blue=24, green=70, pink=160). IRAC strips also cover roughly the same $15' \times 1^\circ$ strips. Latitudes are (for 105.6°) $b=-1.3, 0.3, 2, 4, 8, 16, 32^\circ$ and (for 254.4°) $b=0, -2, -5, -9, -14^\circ$.*

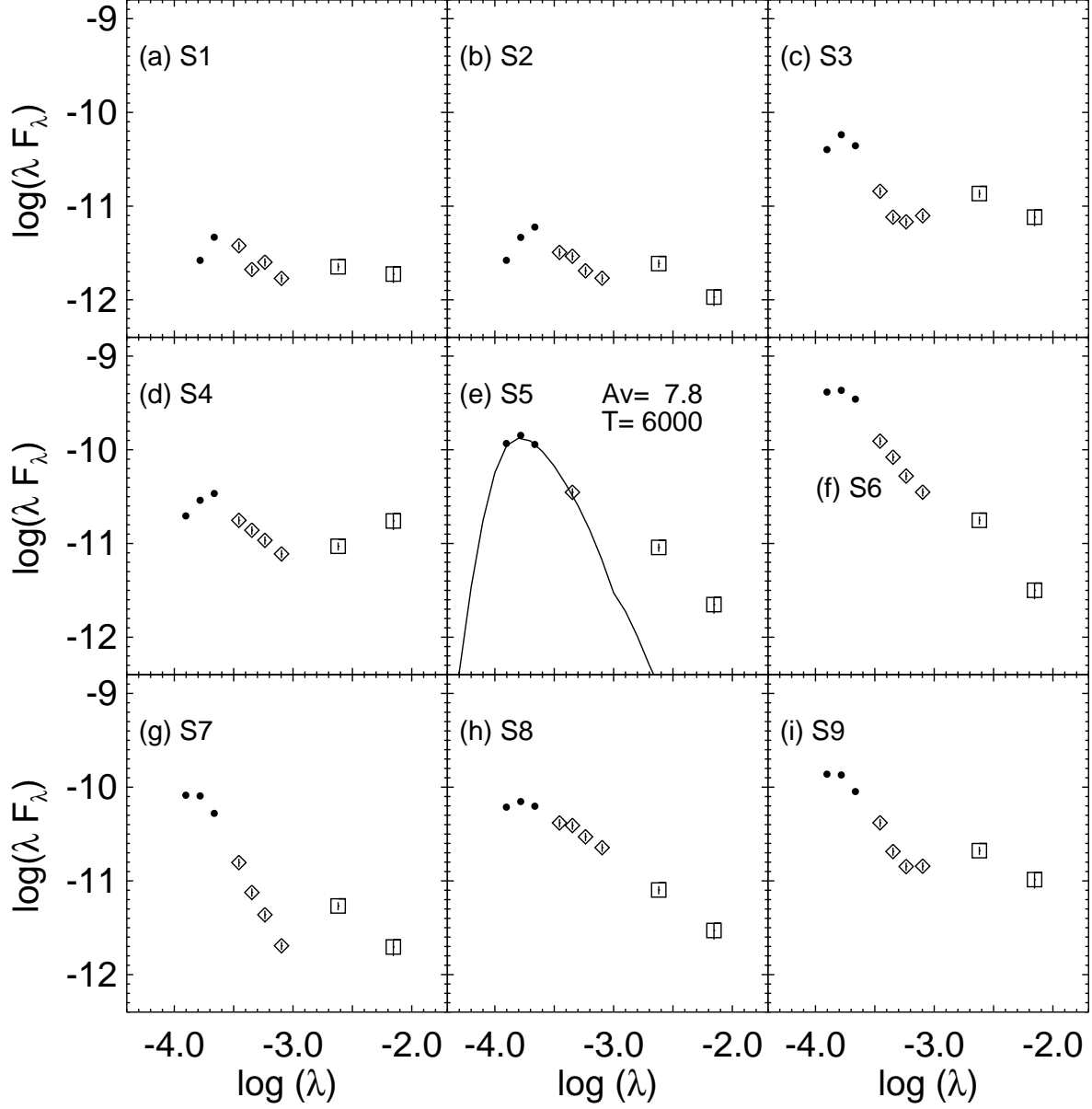


Fig. 2.— *SEDs of objects in aggregate just south of L1228.* Fit plotted in the center panel is a representative reddened blackbody fit to JHK+IRAC ch. 1. Note prominent excesses in IRAC and MIPS bands.

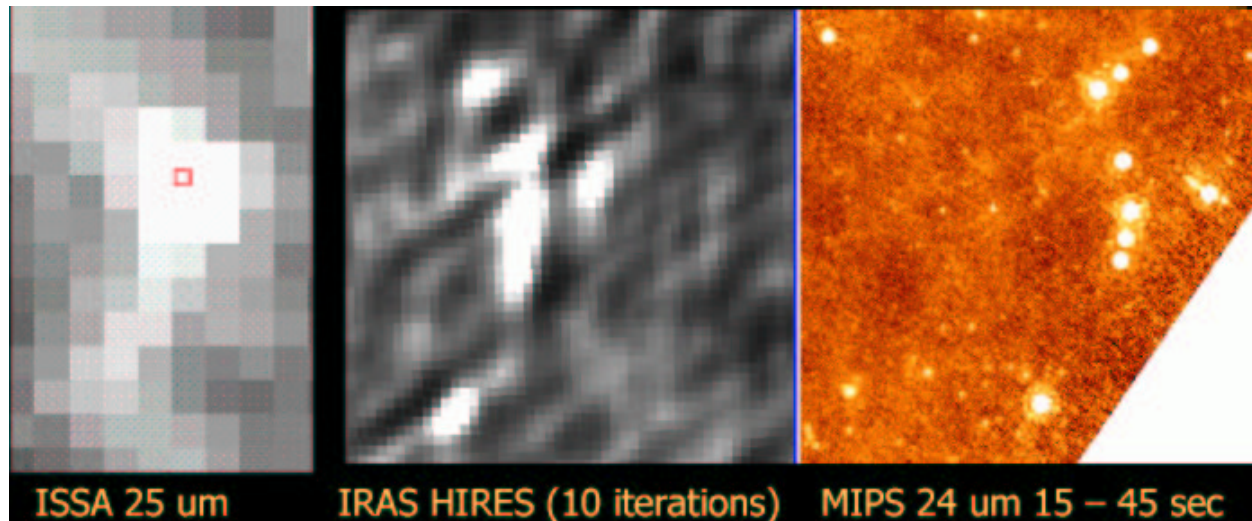


Fig. 3.— *Comparison of IRAS and MIPS observations of this region. IRAS does pretty well, but MIPS goes much deeper, faster, and with better resolution.*

3. Field 105.6, +4 (L1188)

The GFLS strip at galactic longitude 105.6, latitude +4 overlaps a region previously known as L1188.

Figure 4 presents a three-color image of the entire GFLS strip, and identifies two newly discovered groups of YSOs. Figure 5 presents the MIPS-24 and MIPS-70 data for specifically these regions.

Color-color diagrams for the entire strip can be found in Figure 6, with representative SEDs in Figure 7. These SEDs are color-coded to correspond with the colors found in Figure 6.

In summary, there are 3141 sources in the entire field detected in ≥ 2 consecutive Spitzer bands. Of these, 77 have SEDs indicative of YSOs. From a 24 μm -selected sample of sources >0.75 mJy ($S/N > 10$), 44/77 (57%) are YSOs based on the color-color diagrams above. The majority of these sources are in the two groups (A&B).

4. Where to get data, software, handbooks

The Spitzer Science Center Website has all the answers! <http://ssc.spitzer.caltech.edu/> To specifically obtain FLS information, see <http://ssc.spitzer.caltech.edu/fls/> Questions? help@spitzer.caltech.edu

5. Acknowledgements

The research described here was partially carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

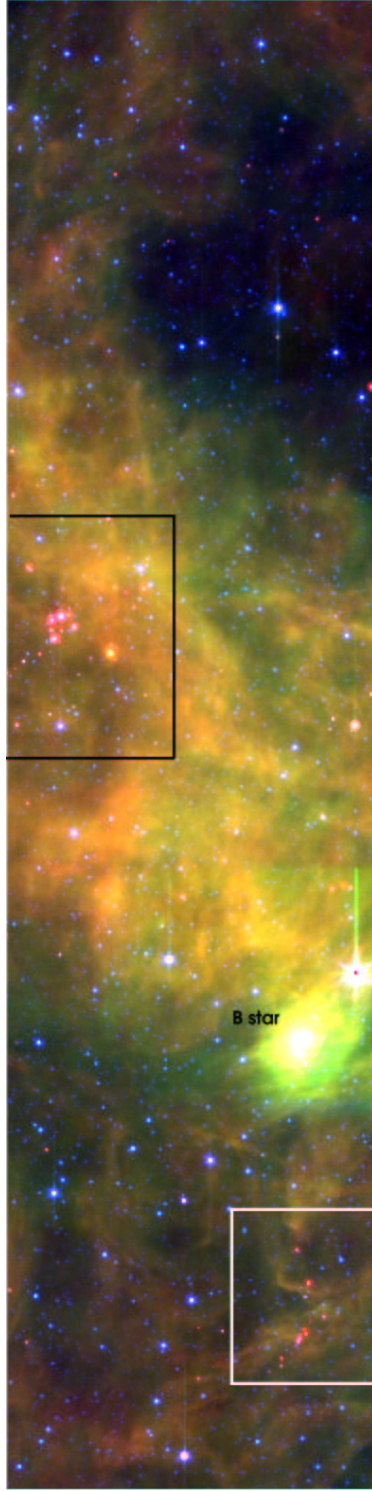


Fig. 4.— *Three-color image of newly discovered groups of YSO's in the $l=105.6$, $b=4.0$ position, which serendipitously pointed at L1188 near the edge the Cepheus bubble. Triggered star formation may be occurring here. Red=MIPS 24 microns, green=IRAC 8 microns, and blue=IRAC 3.6 microns. The black and white boxes indicate newly discovered groups of young stellar objects. Based on CO velocity data from the Canadian Galactic Plane Survey, the inferred distance to group A (black box) is ~ 0.9 kpc, and the distance to group B (white box) is ~ 6.7 kpc, suggesting star formation in a distant arm.*

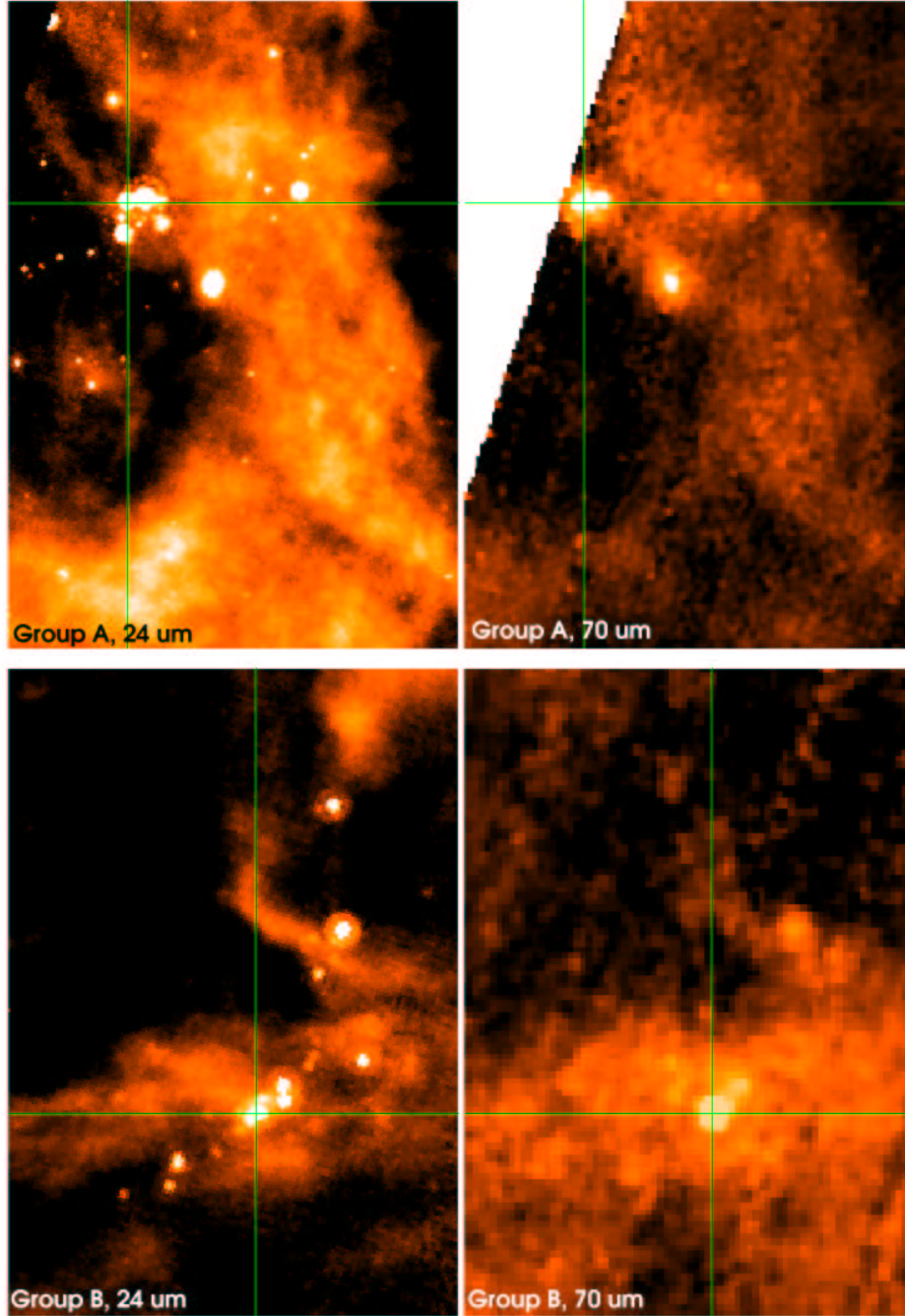


Fig. 5.— *MIPS* images from the same L1188 regions as next figure. Some sources are seen at both 24 & 70 μm , indicating the presence of cooler dust envelopes around these YSOs.

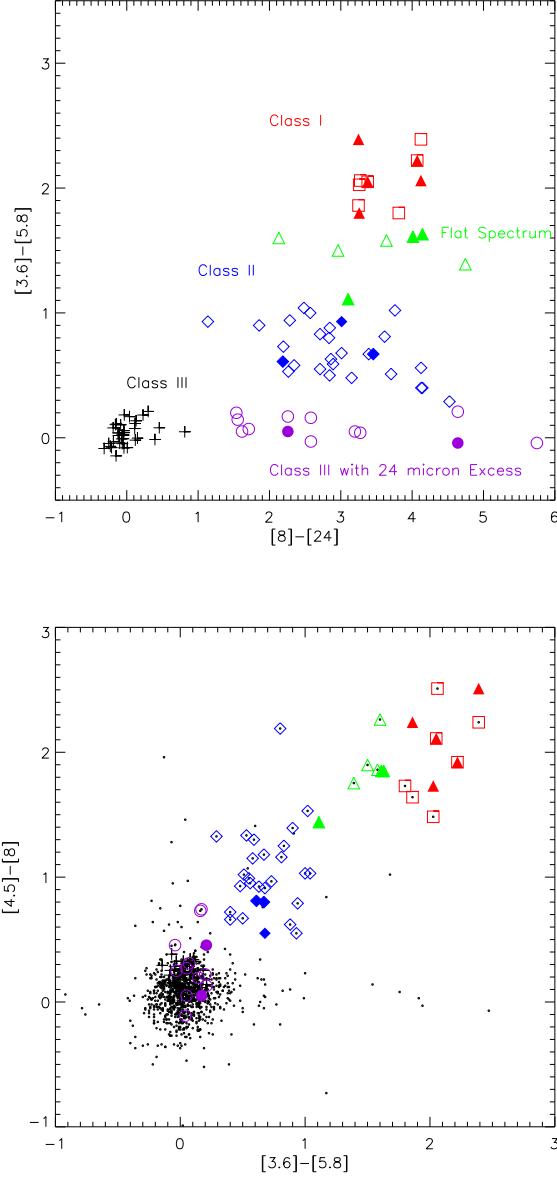


Fig. 6.— *IRAC/MIPS 24 micron and IRAC color-color plots* for sources in the field, color coded by location in the MIPS-IRAC color space. Solid symbols correspond to sources from the highest density regions of Groups A and B. YSOs are shown in color and the cluster of sources at the origin of each diagram (shown in black) have photospheric colors. About 75 objects are in the top plot and about 1100 objects are in the bottom plot. All detections are at least 10σ in each band.

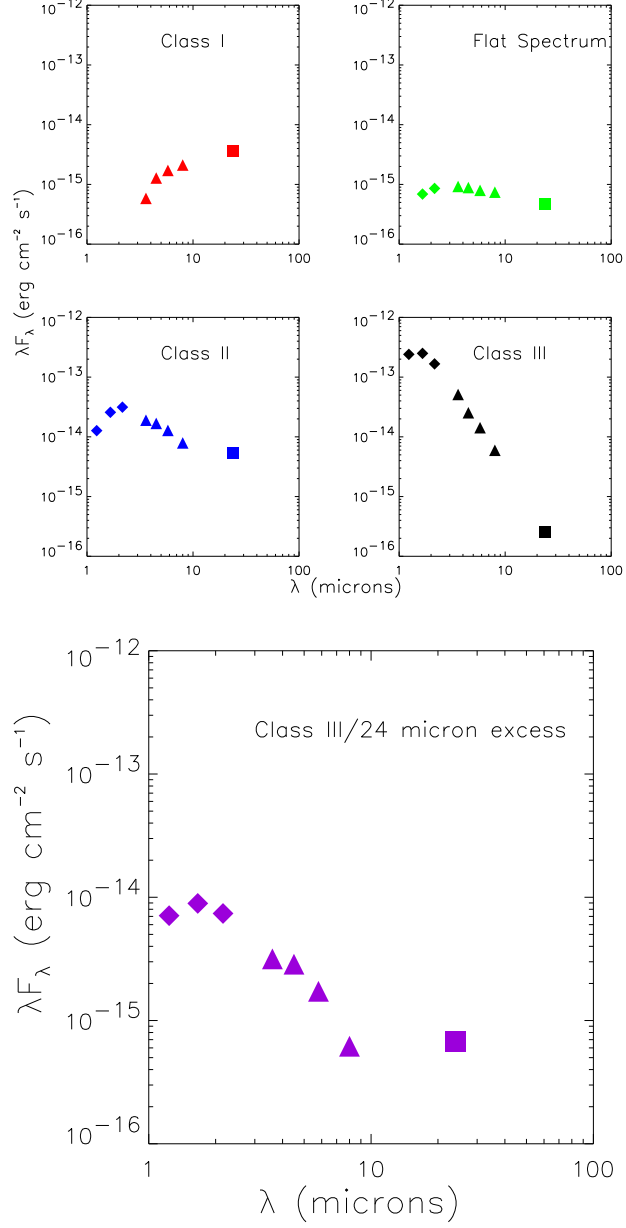


Fig. 7.— *Representative 2MASS - MIPS 24 μm SEDs of sources in the field*, color-coded as in the previous image. Classifications are based on the K_s to 8 μm slope (α). The final SED is that of a Class III source with 24 μm excess, possibly indicative of a debris disk or a disk with a substantial inner hole. The 2MASS data are of a different epoch, and sources may be variable in the near infrared.